Impact of basic transthoracic echocardiography at district hospital level

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Declaration:

The research reported is based on my own independent work. Neither the whole work nor any part of it has been, is being, or is to be submitted for another degree to any other university. This work has not been reported or published prior to registration for the abovementioned degree.

Signed on 4 December 2015 at Sea Point, Cape Town.

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Abstract

Background: The use and demand of echocardiography has increased worldwide. In developed countries, this has not been translated into improved access outside tertiary centres. Previous studies have favoured the appropriate use of echocardiography over its clinical impact, limiting generalisability to resource-constrained settings.

Objectives: To assess the impact of an echocardiographic service at district hospital level in Cape Town, South Africa.

Methods: A prospective, cross-sectional study was performed. A total of 210 consecutive patients, referred to the echocardiography clinic over a five-month period, were recruited. Transthoracic echocardiography was evaluated by its indication, new information provided, correlation with referring doctor's diagnosis and subsequent management plan. Impact included the escalation and de-escalation in treatment, as well as usefulness without a change in management.

Results: The results show that 84% of the patients' management was impacted by echocardiography. Valvular lesions were the main indication. The most frequent contribution was information provided towards the diagnosis of heart failure and assessment post-myocardial infarction. Fifty-six per cent of the echocardiograms confirming the referring doctor's diagnosis still had a significant impact. The rational prescription of medication had the major impetus, followed by de-escalation of therapy and screening patients for referral to tertiary facilities.

Conclusion: Echocardiography has a positive impact on patient management outside tertiary settings, where the definition of impact appears to be different. The value of a normal study, screening prior to upstream referral and usefulness irrespective of change has been established. This should alert policy makers towards the risk of restricted access and promote training.

Introduction

The use of and demand for echocardiography have shown a marked increase worldwide.[1] As special investigation it provides accurate haemodynamic as well as anatomic information non-invasively at the bedside.[1-3]

Developing countries are showing a steady rise in non-communicable diseases, with cardiovascular diseases proving the largest burden in South Africa.[4,5] The dual burden of communicable and non-communicable diseases is disproportionally affecting vulnerable lower-income groups in urban settings.[4] Ironically, patients accessing hospitals with the least available specialist expertise were shown to have the highest number of co-morbidities.[6] Access to special investigations such as echocardiography, a skill still held mainly by specialist cardiologists, remains restricted and uneven in South Africa.

Recent advances in the developed world include open access echocardiography (OAE), which is requested and the results thereof acted on by general practitioners, hand-held devices as well as point-of-care studies by non-cardiologists.[2,7-9] Other than screening patients, appropriate care can be implemented at an earlier stage and waiting times for or referrals to tertiary care can be reduced. The main limitation for the roll-out of echocardiography to primary care is the lack of training.[10]

A few recent studies have reviewed the utility of echocardiography in large, mainly tertiary centres in the developed world.[11-13] The use of echocardiography is mainly driven by appropriate use criteria (AUC) in these settings. These AUC identify common clinical scenarios where echocardiography can be applied and aim at improving health outcomes by means of the equitable allocation of resources in cardiovascular imaging.[14] There is a paucity of data regarding the impact of echocardiography in sub-Saharan Africa. Various definitions of impact and the different concepts of a district or general hospital limit the generalisability to resource-constrained areas, where the clinical impact of echocardiography may be of more value than the broadly accepted clinical indications.

Therefore, our objective was to assess the clinical impact of an echocardiographic service in a district hospital in South Africa. Further conclusions on the demand to access and need for training in echocardiography were drawn.

Methods

A prospective, descriptive, cross-sectional study was conducted at Victoria Hospital, a district-level hospital in Cape Town serving a patient population of nearly 600 000 (2014), consisting mainly of low and middle socio-economic groups. The study cohort consisted of patients referred to the once-weekly echocardiography service, during a 14-week period between September 2013 and January 2014.

Recruitment of study participants was held on the day of the pre-booked echo appointments. All in- and outpatient referrals were considered, regardless of age and comorbidities. Patients unable to give written consent were excluded. Only screening transthoracic echocardiography (TTE) was included and performed by a registered cardiologist, accredited to perform echocardiography.

EpiCalc (freeware, Version 1.02, 2000) was used to calculate the sample size. It was assumed that 80% of management would change due to results of the echocardiogram. As the study describes a single proportion, to achieve a confidence level of 95%, with a precision of 5% (thus a margin of error of 10%), a sample size of 245 patients was required.

Data were collected prospectively, meaning as the echo was performed. One questionnaire was completed by the participant, with the help of a research assistant, and pertained to patient characteristics and medical history. The cardiologist who performed the echocardiogram completed a second questionnaire in order to establish its impact by assessing the indication, new information obtained from the echocardiogram, correlation with the referring doctor's diagnosis and the management plan thereafter. AUC were used to classify indications explicitly. The average waiting period was randomly calculated on four dates, reviewing the time until the next available appointment.

The cardiologist conducted the echocardiograms using a Toshiba Nemio machine, using an adult echocardiography probe PST-25AT (1.8–4.2 mHz). The patients were screened in the supine and left lateral positions. Examinations were viewed in real time and done in standard transthoracic views, parasternal long and short axis with apical four-chamber views; subxyphoid views were included when indicated. M-mode, 2D and colour flow Doppler were utilised. Ejection fraction was measured using the Teicholz method.[15] Regional wall motion was visually evaluated in the above-mentioned views. Continuous Doppler was not available on the machine, but colour flow Doppler was used when necessary. M-mode recording was done and printed out when deemed necessary, but not stored. The echocardiograms performed were for screening purposes only and were not standard transthoracic evaluations. Even though some patients had repeated TTE, most patients did not have a baseline standard study.

Impact was classified according to adapted criteria (Table 1).[11-13]

Table 1: Clinical impact criteria

Impact level		**Description**
Active	Escalation	More rational drug therapy Confirmation of vegetation Cardioversion required Referred for further imaging (angiography or nuclear medicine study) Referred to tertiary cardiology services Other referrals: palliative care programme, disability grant assessment
	De-escalation	Reassurance of normal study, omitting further testing or avoiding further referral
	No change, but clinically useful	Contesting clinical suspicion / diagnostic value Repeat echo advised / monitoring purpose Cleared for theatre
No impact		Continue current management plan Confirming clinical suspicion with no change in management

Total impact = Escalation + De-escalation + No change, but clinically useful

Data were captured with Excel v14.0.0 (Microsoft, 2011) and analysis was performed on Stata 12.0 (Statacorp, Texas, 2011). Where data were not normally distributed (e.g. age), a Kruskal-Wallis test was used. Pearson chi-square tests or Fisher exact (if the expected frequency of a group was smaller than 5) were used to calculate the statistical significance of the different proportions. Statistical significance was accepted as a p-value of less than 0.05. Prevalence ratios were then calculated. Absent data were perceived as missing completely at random, as categorical data were collected as tick sheets.

This study was approved by the Health Science Research Ethics Committee of the University of Cape Town (HREC 382/2013). Each participant voluntarily agreed to participation in the study by means of written consent. A study number was allocated to each participant in the data sets in order to ensure confidentiality.

Results

A total of 210 participants were recruited (see Figure 1). Approximately one-third of the patients did not attend their appointment date. Patient characteristics, comorbidities and referral patterns, all in relation to the overall impact level each group was associated with, are tabulated in Table 2. The majority of the participants were referred by the Medical Department, either from the ward or via the Outpatient Department.

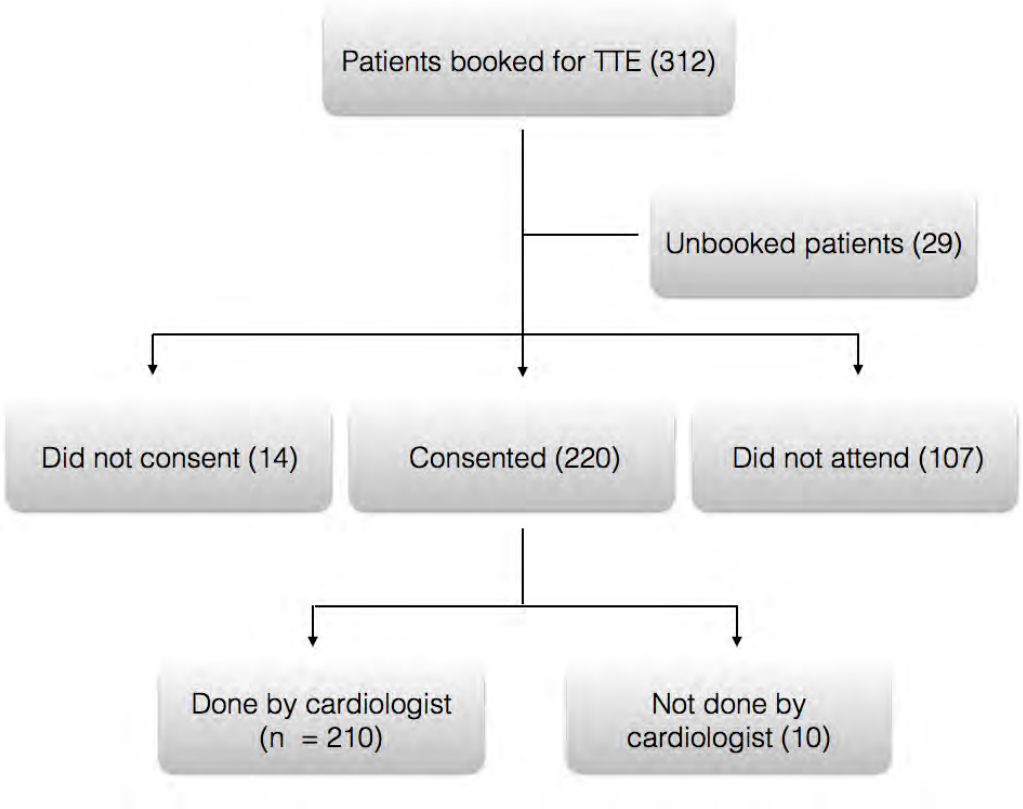


Figure 1: Recruitment of participants

Self-reported and documented comorbidities noted nine (4.29%) HIV-positive participants, five cases (2.82%) of rheumatic heart disease and four (2.26%) participants with a previous mitral valve replacement, all associated with impact. It was not documented whether these valve replacements were initially indicated for rheumatic heart disease.

Of the participants, 131 (62.38 %) had a smoking history, one-third of these indicating a current smoking habit. Of those older than 16, 34 (17.44%) indicated that they were employed, while 29 (13.81%) received disability grants and 63 (30%) were pensioners.

An average number of 17 echocardiograms were performed per clinic during the study period. The average waiting time, until the next available appointment, was 89 days.

Table 2: Patient characteristics referred for TTE

	Total impact		**No impact**		**Total**	
Age (mean, minimum, maximum)	52 (2, 86)		60 (25; 87)		50 (SD 20,13)	
Male	90	51.14%	18	52.94%	108	51.43%
Female	87	49.43%	15	44.12%	102	48.57%
Employed (> 16 years old)	27	15.34%	7	20.59%	34	17.44%
Pensioners	49	27.84%	14	41.18%	63	30.00%
Receiving DG	24	13.64%	5	14.71%	29	13.81%
Currently inpatient	48	27.27%	5	14.71%	53	25.24%
Referring facility						
Medical ward	76	43.18%	16	47.06%	92	43.81%
ED	34	19.32%	7	20.59%	41	19.52%
MOPD	32	18.18%	9	26.47%	41	19.52%
POPD	12	6.82%	0	0	12	5.71%
CHC	12	6.82%	0	0	12	5.71%
DH	5	2.84%	0	0	5	2.38%
Private sector	1	0.57%	0	0	1	0.48%
Other	4	2.27%	1	2.94%	5	2.38%
Unknown source of referral	1	0.57%	0	0	1	0.95%
Comorbidities						
Hypertension	91	51.70%	28	82.35%	119	56.57%
Ischaemic heart disease	54	30.68%	13	38.24%	67	31.9%
Hypercholesterolaemia	49	27.84%	12	35.29%	61	29.05%
Diabetes mellitus	40	22.72%	9	26.47%	49	23.33%
Cardiac failure	30	17.05%	6	17.65%	36	17.14%
Atrial fibrillation	16	9.09%	2	5.88%	18	8.57%
COPD	15	8.52%	2	5.88%	17	8.1%
Known cardiomyopathy	13	7.39%	3	8.82%	16	7.62%
Stroke	12	6.82%	1	2.94%	13	6.19%
HIV	9	5.11%	0	0	9	4.29%

Thyroid disease	8	4.55%	0	0	8	3.81%
Obesity	4	2.27%	2	5.88%	6	2.86%
Rheumatic heart disease	5	2.84%	0	0	5	2.38%
Mitral valve replacement	4	2.27%	0	0	4	1.9%
Habits						
Ex-smoker	70	39.77%	15	44.12%	85	40.48%
Current smoker	38	21.59%	8	23.52%	46	21.9%
Alcohol	30	17.04%	9	26.47%	39	18.57%
Drugs (ex or current)	16	9.09%	1	2.94%	17	8.1%
TOTAL (n =)	**176**	**83.81%**	**34**	**16.19%**	**210**	**100%**

ED: Emergency Department; MOPD: Medical Outpatients Department; POPD: Paediatric Outpatients Department; CHC: Community Health Care Centre; DH: (Neighbouring) District Hospital; COPD: Chronic Obstructive Pulmonary Disease

Two main groups "Total impact" and "No impact" each has subset per criterion, tabled by number and percentage, e.g., Ex-smokers: 70 (39.77%) associated with "Total impact" and 15 (44.12%) associated with "No impact". Percentage in brackets calculated per main group, e.g. 15 participants of all those with "no impact" (i.e. out of 34 participants) were non-smokers.

Clinical use and association with impact

Our study found that 84% of TTEs had an impact on patients' management. In total, 51% resulted in an escalation and 19% in de-escalation of management, while 14% had an impact without a change in management.

Valvular lesions were the main indication for referral (Table 3). Only one patient's indication was seen as inappropriate when compared to AUC.[14]

Table 3: Indications and their association with clinical impact

	Total impact		**No impact**		**Total**		**Prevalence ratio (95% CI)**
Evaluation of valvular function	66	37.5%	7	20.59%	73	34.76%	1.01–1.26
Unknown cause of heart failure	47	26.7%	7	20.59%	54	25.71%	0.93–1.19
Post-myocardial infarction (for regional wall motion abnormalities)	26	14.77%	9	26.47%	35	16.67%	0.61–0.90

Suspected hypertensive heart disease	18	10.23%	16	47.06%	34	16.19%	0.38–0.72
Rhythm abnormality on ECG	31	17.61%	1	2.94%	32	15.24%	1.08–1.31
Cardiomegaly, found clinically and radiologically, not known with CCF	22	12.5%	2	5.88%	24	11.43%	0.97–1.27
Known cardiomyopathy	13	7.39%	3	8.82%	16	7.62%	0.79–0.89
Evaluation of chest pain of unknown cause	14	7.95%	2	5.88%	16	7.62%	0.86–1.27
History suggestive of arrhythmia, e.g. palpitation, light-headedness, pre-syncope or syncope	14	7.95%	0	0	14	6.67%	0.78–0.88
Evaluation of cardiovascular source of embolus	9	5.11%	1	2.94%	10	4.76%	0.87–1.34
Other	21	11.93%	1	2.94%	22	10.48%	-
TOTAL (n =)	**176**	**83.81%**	**34**	**16.19%**	**210**	**100%**	

Other: Pulmonary hypertension, suspected infective endocarditis, new cardiomyopathy, evaluation of aortic disease, suspected pulmonary embolism
ECG: Echocardiogram; CCF: Congestive cardiac failure
Note: One participant may have more than one indication for TTE.

The major contribution of TTE was the information provided in the diagnosis of heart failure (29.0%) and ischaemic heart disease (23.8%) (Table 4). Of all participants, one-third have impaired left ventricular (LV) function. Three cases of apical thrombi were identified post-myocardial infarction, which resulted in the initiation of anticoagulation therapy.

The most common valve lesions identified, in order of prevalence, are tabulated separately (Table 4). Of these, mitral stenosis, discerning aortic scleroses from stenosis, identifying non-pathological murmurs and aortic regurgitations were statistically significantly associated with clinical impact. In addition to the five known prior to the TTE, three more participants were diagnosed with rheumatic heart disease; the total prevalence being 3.8% in our study cohort.

Six participants were diagnosed with cor pulmonale and four with pulmonary hypertension, none of them known to be suffering from COPD.

Table 4: New information found on TTE

	Total impact (n = 176)		**No impact (n = 34)**		**Total (n = 210)**		**Prevalence ratio (95% CI)**
Detection of LV systolic dysfunction	57	32.39%	9	26.47%	66	31.43%	0.93–1.18
Cause of heart failure established	28	15.91%	6	17.65%	34	16.19%	0.82–1.16
Cause of heart failure confirmed	24	13.64%	3	8.82%	27	12.86%	0.92–1.24
Total: heart failure					*61*	*29.05%*	
Wall motion abnormality found	28	15.91%	4	11.76%	32	15.24%	0.91–1.22
Wall motion abnormality ruled out	12	6.82%	6	17.65%	18	8.57%	0.48–0.92
Total: wall motion abnormalities					*50*	*23.81%*	
Left ventricular hypertrophy (LVH)	29	16.48%	14	41.18%	43	20.48%	0.54–0.82
Congenital heart disease	4	2.27%	0	0	4	1.9%	0.79–0.89
LV aneurysm	1	0.57%	0	0	1	0.48%	0.78–0.89
Valvular lesions							
Mitral regurgitation	56	26.67%	5	15.15%	61	29.05%	1.01–1.25
Tricuspid regurgitation	34	16.19%	5	15.15%	39	18.57%	0.90–1.19
Aortic sclerosis discerned from aortic stenosis	21	11.93%	9	26.47%	30	14.29%	0.55–0.88
Aortic stenosis	17	8.10%	3	9.09%	20	9.52%	0.83–1.23

Functional murmur	15	8.52%	0	0	15	7.14%	0.77–0.88
Mitral stenosis	14	6.67%	0	0	14	6.67%	0.78–0.88
Aortic regurgitation	8	3.81%	0	0	8	3.81%	0.79–0.89
Total (n =)	**176**	**83.81%**	**34**	**16.19%**	**210**	**100%**	

Despite the fact that 56% (118 participants) of all TTEs confirmed the referring doctor's diagnosis, these were still statistically significantly linked to impact (CI 0.64–0.80) (Figure 2). Of all TTEs, 39% (82 participants) contested the pre-referral diagnosis. In total, 88% (30 participants) of TTEs who did not have an impact were associated with an accurate correlation with pre-referral assessment.

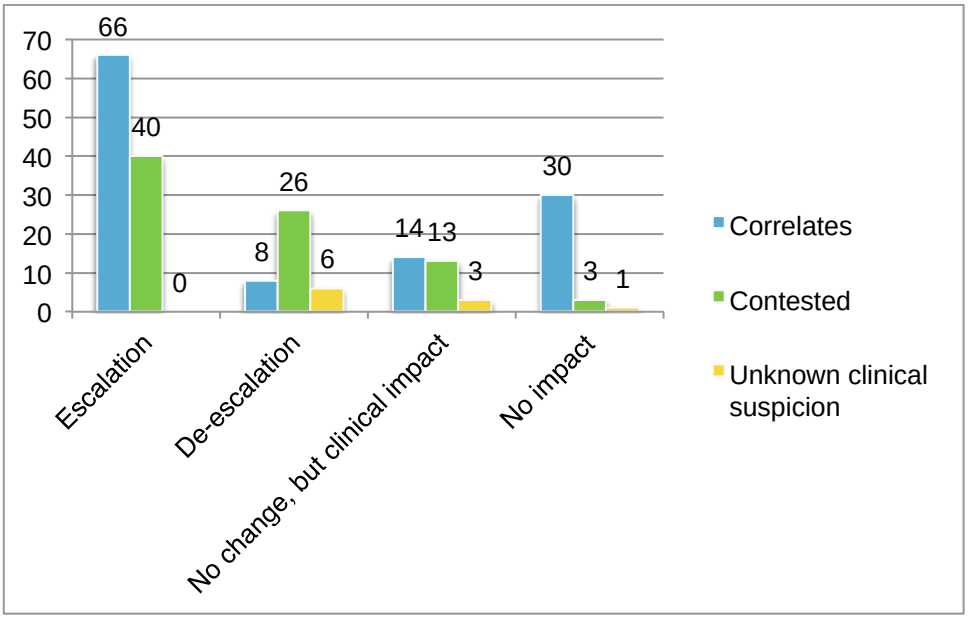
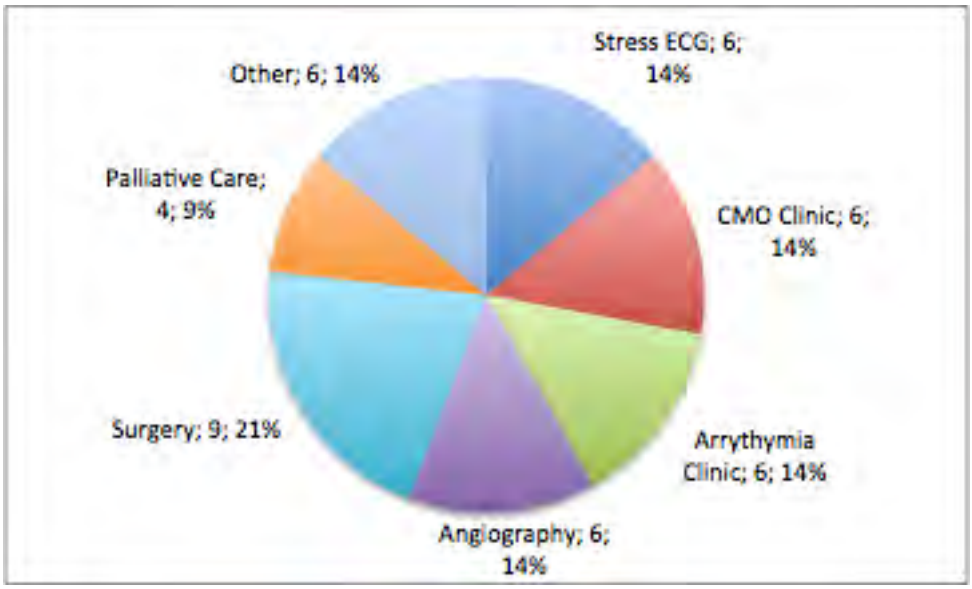


Figure 2: Correlation of referring doctor's diagnosis with impact of echo.

Spectrum of clinical impact

TTE was found to be most useful in the rational prescription of medication (80 participants). Twenty-seven participants, one-fifth of those who had an escalation in management, required referral to tertiary services (Figure 3). Of these upstream referrals, nine patients were referred for surgery: five were for valve replacements, three for the correction of atrial septal defects and one for surgery of a myxoma. Three patients required referral to the hospital's social worker for a disability grant due to the severity of their disease.

Figure 3: Upstream referrals after echo.
CMO: Cardiomyopathy; ECG: Electrocardiogram
Legends: Impact or upstream referral clinic; number of cases; percentage of escalated management



De-escalation of care, back to the primary health care services, was recommended in 40 cases. Fifteen participants were offered reassurance for non-pathological murmurs and six participants for idiopathic chest pain, preventing further testing or referral to a higher level of care. The remaining half of this group benefited by TTE ruling out cardiac sources of emboli, structural causes for perceived arrhythmia (symptomatic or on electrocardiogram), pulmonary hypertension and infective endocarditis.

Echocardiograms performed on 29 participants resulted in no change in management, but provided clinically useful information. Of these, two-thirds (16 participants) were advised to have follow-up echocardiograms (implying monitoring of current condition), 11 participants had contested the referring doctor's diagnosis prior to the echocardiogram and two were cleared for surgery.

Behavioural advice, for example direct advice on alcohol consumption, weight reduction and smoking cessation, was documented, but not analysed. Three female patients were advised against future pregnancies due to postpartum cardiomyopathy.

Discussion

Our study found that the vast majority (83.8%) of echocardiograms had a positive impact on patients referred to a district hospital – a proportion even higher than reported in settings of developed countries (32–76%).[12,13] The diversity of patients' ages, comorbidities and sources of referral indicated the broad practice and value of this mode of investigation.

The value of a prospective study is that single echocardiographic assessment in a non-tertiary setting can immediately address a focused, clinical question or suspicion raised, which may immediately indicate the impact or the lack thereof. This definition

of impact appears to be different from previous larger impact studies, which were done either in tertiary settings or in community hospitals that had cardiology services available.[12,13] A few older studies done at district hospitals either reviewed the impact more than 30 years ago, using only M-mode, or focused on the intensive care units.[3,16,17] The lack of generalisability to current district hospital practice seems obvious, especially in resource-constrained settings.

We have established the role of de-escalation in therapy and continuation of management. This potential decrease in referral to tertiary specialists seems similar to other studies.[7,9,18] Previous studies have cautioned about undervaluing a normal study.[8,11,19,20] This benefit has been proven by our study by TTE having impact in 32.9% (n = 69) of all the participants referred, without escalating management. Its use in screening pre-screened patients is evident, with a particularly high impact level in all paediatric patients, mainly aiding in de-escalation of services after a murmur had been auscultated prior to referral. This has been undervalued by previous studies.[12,16] Our study has shown that impact does not necessarily translate into a change in management. Many patients require follow-up; this is seen as valid indications in itself in early and late stages of disease, without even having a change in clinical status.[14]

The major change in management appeared to be the rational prescription of medicine. The other main benefit was determining which patients require up-referral to tertiary services, for example those requiring surgery.

South Africa does not use AUC. However, the fact that 99% of indications could be classified accordingly indicates the high appropriate use in our district hospital. The most common indication in our case was suspected valve disease. Its significance could not be statistically linked to impact, perhaps owing to the small sample size achieved. New information gathered was nonetheless significant for mitral stenosis and aortic regurgitation; this echoes the finding of a previous audit of the beneficial value of assessing diastolic (more than systolic) murmurs.[16] Three adult participants, yet no paediatric patients, were newly diagnosed with rheumatic heart disease. A recent study in South Africa has shown the decrease in rheumatic heart disease in children in South Africa, which may be due to improved access to health care and an improved socio-economic environment.[21] The use of echocardiography as a screening tool for rheumatic heart disease is yet to be translated into its impact on prognosis and effective secondary prophylaxis for subclinical disease. Results suggest that adults may benefit more from screening than children.[22]

Of all indications for echocardiography, assessment of regional wall motion abnormalities and suspected hypertensive heart disease were statistically significantly associated with impact. The value of echocardiography in assisting with the prognosis in these two settings has previously been proven.[23,24] One study found that the evaluation of wall motion abnormalities is the most statistically significant, independent prognostic data provided by TTE.[23] Even though the screening of all hypertensive patients when LVH is diagnosed has been suggested, as this implies a worse diagnosis, others feel that it probably would not intensify the treatment of the hypertension itself.[25,26]

In our study, heart failure did not comprise the majority of indications, which was the case in a systematic review of patients referred for OAE from primary care.[26] The role of TTE in providing new information in this context is nonetheless unsurpassed, by detecting LV dysfunction and either establishing or confirming the cause of failure.[18] This is of particular value in our setting, where heart failure is usually diagnosed and monitored by clinical means only. Diastolic dysfunction was not captured. The distinction from systolic dysfunction can be valuable, as echocardiography is the best non-invasive tool to confirm this, especially in light of its difficult assessment by means of physical examination.[27] Despite two-thirds of the cohort having a smoking history, low numbers of COPD and its complications were reported. Screening for and assessing cardiac complications, such as cor pulmonale and pulmonary hypertension, in patients with COPD can be useful, as both infer increased morbidity and mortality.[28] The diagnosis of a clinically unsuspected atrial myxoma in this small cohort was noted as a finding that would otherwise have remained undetected.

Discrepancies between the results of the TTEs and the assessment of the doctor prior to the test were confirmed as per previous studies.[18,29,30] It appears that the positive impact of TTE is independent of the clinical accuracy of the referring doctor. On the other hand, a lack of impact was nonetheless associated with accurate pre-referral assessment. This may indicate that a thorough history and physical examination may lessen the need for a diagnostic test.[19] Thirty-nine per cent of the echocardiograms disproved the pre-referral diagnosis and these consequences should be considered.

In the present study, some of the participants had previous TTEs. A repeat echocardiogram still had an important clinical impact. A former study found the added diagnostic value of echocardiography to be significantly independent from whether this test was previously performed.[19]

Approximately one-fifth of the patients were referred from the hospital's emergency department; this may indicate the need for training in question-focused, point-of-care studies. A review of TTEs performed by non-cardiologists showed an active change in management in 16 to 37% of patients in an emergency setting.[9]

A lack of referral of patients from primary health care facilities was found despite doctors being able to refer patients directly for TTEs. It is unclear whether the medical staff in these facilities are aware of this service. However, of the few patients in this study cohort who were referred from community health care settings, the echocardiograms were associated with notable impact.

The waiting time for the next available appointment was six times as long as the recommended time period of two weeks advised by the National Institute for Care Excellence guidelines for patients with chronic heart failure and post myocardial infarction.[31] A Dutch study of OAE reports a waiting time of five weeks.[7] In developing countries, a lack of resources and scarce skills may be the reason for this long waiting time. The poor socio-economic status of the participants, including pensioners and those receiving disability grants, may indicate the reliance on public sector facilities. The poor attendance for TTE appointments shows the undervaluing of this restricted resource. Often, non-attendance is due to lack of funds for transport. Having this service only at a distant tertiary centre may add to poor attendance.

Limitations

Our study does have some limitations. The participants were referred from the hospital ward or outpatient departments and have been pre-screened after being admitted via the emergency department or referred from a primary health care facility. This may overvalue the impact owing to a lower incidence of negative findings. Patients with acute cardiac illness, such as heart failure or myocardial infarction, may be more likely to benefit from echocardiograms. Any new information provided by echocardiography may be perceived as beneficial. No true comparator exists to match its value in imaging function and structure.

Owing to the limited availability of TTEs in this setting as well as the inclusion of hospitalised patients, the likelihood of appropriate referrals by doctors will probably be higher.[11,32] Patients from the community have been found to have a lower pre-test probability and are mainly referred to exclude disease.[33]

The echocardiographer in our study is an experienced cardiologist. His specialist assessment in itself may have an impact on patients' management, causing the impact of the TTEs to be overestimated. The risk of possible bias exists, as this cardiologist performing the echocardiograms was also involved in the clinical decision-making process and management of the patients. We aimed to limit this bias by using pre-set questionnaires. The echocardiographic assessments were not comprehensive echocardiograms. This study did however not aim to address diagnostic accuracy.

No particular guidelines were agreed upon in the study protocol. The questionnaire completed by the cardiologist during data collection indicated a binary option of whether a finding was present or not. Different measurements, e.g. valve area for stenotic lesions or pulmonary pressures in pulmonary hypertension, may have been done, but were not captured.

The study size was smaller than initially anticipated, mainly because of patients defaulting on their appointments.

Following the participants' completion of the questionnaires, all data were checked afterwards to correlate with the clinical information in their folders. This allowed for more accurate analysis of the patient characteristics and the echocardiograms as well as their indications. Fifteen patient folders were missing and were not checked retrospectively.

The downstream risks of TTE, such as incorrect interpretation and residual anxiety despite a normal study, should not be disregarded.[1,14,34]

It would be important to gain insight into whether clinical impact and changes in management eventually translate into improved health outcomes in primary care. These effects could be assessed in a follow-up study. Other than its clinical impact, the cost implications of a restricted resource should be studied. This should rather be done in a cost-analysis and not an impact study. In a stressed economic environment of cost-containment, the various accepted indications lend themselves to remunerative abuse.[1] Remuneration is of less concern in the public sector than access and ethical principles, such as distributive justice.

Conclusion

Echocardiography has a positive impact on patient management in a district hospital setting. The limited access for patients may negatively impact their management, as a valuable contribution of TTEs to overall management was found. The burden of non-communicable conditions is evident in the cohort referred for this service.

A normal echocardiographic study is important by offering patient-centred reassurance, offering diagnostic value to the doctor and aiding in down-referral back to the primary level of care. In the overburdened public health sector, where continuity of care is frequently a problem, it may reduce time and costs. By providing these services in non-tertiary settings, patients can be screened and more appropriately referred to scarce upstream specialists and sub-specialist departments.

Training in interpretation and accreditation in the use of echocardiography should be a priority for teaching and academic facilities, especially for those working in general, emergency and family medicine. The prospect of hand-held devices would definitely enhance access, but may compromise quality.

On a practical level, the training in basic echocardiography may empower other health care providers, such as general practitioners with a special interests in cardiology, to provide care at district facilities whilst tertiary-based cardiologists may have an advisory role only. Many conditions can then be promptly managed in the non-tertiary setting, albeit the primary health care (as in OAE) or the district health system, without the assessment of a cardiologist. It may lead to more appropriate use of and referral to cardiologists. The benefits of more accurate diagnosis, improving rational prescription and decreasing the burden on the tertiary health care system should be evaluated. A patient-centred approach can also evaluate patients' own perception of impact on their illness.

Policy makers should be alerted to the added value offered by TTEs of an echocardiographic assessment and the risk of its restricted access, especially when comparing its essential practice in developed countries. The rapidly growing burden of non-communicable diseases urges investment in greater accountability and equity of service-based interventions to local communities.[4,33] Some services have shown promise by altering the concept of open access to "managed direct access",[20] by prioritising referrals according to appropriateness and impact. District hospitals can establish protocols in the communities they serve to assist with procurement and referrals from primary health care.

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